BREEDS OF UKRAINIAN SELECTION AND THEIR PRODUCTIVITY IN THE CONDITIONS OF WESTERN FOREST STEPPE

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This article covers the list of precocious soybean varieties (Ukrainian Selection) for the purpose of studying them in the conditions of Western Forest-Steppe zone of Ukraine. The research was conducted during 2017–2020 at the experimental field of Crop Production Technology Department of the Lviv National Environmental University.

In these studies, the following soybean varieties were used, namely Ustia, Khvylia, Muza, Arnica, Vilshanka, Siverka, Suziria, Vyshyvanka, originated by the Institute of NSC «Agriculture of the National Academy of Sciences». These varieties belong to the early-germinating group that means their growing season ranges from 83 to 107 days, and they are also characterized by increased resistance to damage by the most common diseases, bean cracking and grain shedding. Considering their early harvest dates, the researched varieties can be used as a precursor for winter crops, and are suitable for harvest crops (Siverka variety).

Ustia variety was entered into the Register of Varieties of Ukraine in 2002. Precocious. Weight of 1000 seeds is 155–160 g. The seeds contain 41–42 % protein and 19–20 % oil. **Muza** variety is in the State Register since 2015, bred by the method of repeated individual selection from Yug-30/Ustia hybrid generations. The weight of 1000 seeds is 235–245 g. The seeds contain 41–42 % protein and 20–21 % fat. **Arnica** variety was entered in the State Register in 2016, bred by the method of individual selection from the combination of crossing two early and productive lines 242 and 427. The weight of 1000 seeds is 155–160 g, seeds contain 40–42 % protein and 20–21 % fat. **Khvylia** variety is in the State Register since 2013, bred by the method of individual selection from the L.364/Cherniatka hybrid population. The weight of 1000 seeds is 158–162 g. The seeds contain 40–42 % protein and 21–22 % fat. The **Vilshanka** variety is in the State Register since 2011, bred by the method of repeated individual selection from the hybrid L.955/Cherniatka. The weight of 1000 seeds is 240–250 g. The seeds contain 41–42 % protein and 21–22 % fat; **Siverka** variety is in the State Register since 2013, bred by the method of individual selection from the Yug-30/Ustia hybrid population. The weight of 1000 seeds is 170–175 g. The seeds contain 41–42 % protein and 20–21 % fat; **Vyshyvanka** variety is in the State Register since 2019. The weight of 1000 seeds is 144–183 g. The seeds contain 38–39 % protein and 22–23 % fat; the **Suziria** variety is medium-ripe, entered into the State Register of plant varieties being suitable for distribution in Ukraine since 2011 in the Forest Steppe and Polissia zones. The weight of 1000 seeds is 220–240 g. The seeds contain 42–43 % protein and 20–21 % fat.

Key words: breed, soybean, productivity, harvesting, quality indicators.

Панасюк Р. Продуктивність нових сортів сої української селекції в зоні Західного Лісостепу України

Висвітлено перелік скоростиглих сортів сої (української селекції) для вивчення їх в умовах зони Західного Лісостепу України. Дослідження проводили впродовж 2017–2020 рр. на дослідному полі кафедри технології у рослинництві Львівського національного університету природокористування.

У дослідженнях використано сорти сої: Устя, Хвиля, Муза, Арніка, Вільшанка, Сіверка, Сузір'я, Вишиванка – установа-оригінатор ННЦ «Інститут землеробства НААНУ». Сорти належать до скоростиглої групи – їхній вегетаційний період коливається від 83 до 107 діб, а також характерний підвищеною стійкістю до ураження найбільш поширеними хворобами, розтріскування бобів і осипання зерна. Досліджувані сорти, враховуючи їхні ранні терміни збирання, можна використовувати як попередник для озимих культур, вони придатні для пожнивних посівів (сорт Сіверка).

Устя – занесений до Реєстру сортів України у 2002 році. Скоростиглий. Маса 1000 насінин – 155–160 г. У насінні міститься 41–42 % білка і 19–20 % олії. Сорт **Муза** – у Державному реєстрі з 2015 року, виведений методом багаторазового індивідуального добору з гібридних поколінь Юг-30/Устя. Маса 1000 насінин – 235–245 г. У насінні міститься 41–42 % протеїну і 20–21 % жиру. Сорт **Арніка** – внесений до Державного реєстру у 2016 році, виведений методом індивідуального добору з комбінації від схрещування двох скоростиглих і продуктивних ліній 242 і 427. Маса 1000 насінин – 155–160 г, у насінні міститься 40–42 % протеїну і 20–21 % жиру. Сорт **Хвиля** – у Державному реєстрі з 2013 року, виведений методом індивідуального добору з гібридної популяції Л.364/Чернятка. Маса 1000 насінин – 158–162 г. У насінні міститься 40–42 % протеїну і 21–22 % жиру. Сорт **Вільшанка** – у Державному реєстрі з 2011 року, виведений методом багаторазового індивідуального добору з гібрида Л.955/Чернятка. Маса 1000 насінин – 240–250 г. У насінні міститься 41–42 % протеїну і 21–22 % жиру; сорт

Сіверка – у Державному реєстрі з 2013 року. Виведений методом індивідуального добору з гібридної популяції Юг-30/Устя. Маса 1000 насінин – 170–175 г. У насінні міститься 41–42 % протеїну і 20–21 % жиру; сорт **Вишиванка** – у Державному реєстрі з 2019 року. Маса 1000 насінин – 144–183 г. У насінні міститься 38–39 % протеїну і 22–23 % жиру; сорт **Сузір'я** – середньостиглий. Занесений до Державного реєстру сортів рослин, придатних до поширення в Україні з 2011 року по зонах Лісостеп і Полісся. Маса 1000 насінин – 220–240 г. У насінні міститься 42–43 % протеїну і 20–21 % жиру.

Ключові слова: сорт, соя, продуктивність, урожайність, показники якості.

Problem Formulation. In the cultivation technology of almost all agricultural crops, including soybeans, the main goal is to obtain optimal and sustainable crops with high quality indicators that is the main factor in assessing the level of economic efficiency of crop cultivation. In the technology of growing soybeans, an important place is given to the correct selection of varieties, which is one of the decisive factors for obtaining maximum yields of the crop. It is known that the variety policy of the soybean growing region is determined depending on the biology of the culture and environmental conditions, since each breed has its own growing region, in which the realization of the genetic potential of productivity is the highest. To date, more than 1000 soybean varieties and hybrids characterized by yields of up to 5.00 t/ha and higher are known in the world agriculture. [2].

Analysis of Recent Research and Publications. According to the results of research [6], it is recommended to sow two or three varieties of soybeans in farms, which differ in the length of their growing season. Thus, in the conditions of the Western Forest-Steppe, it is advisable to sow the following soybean varieties: in the north of the subzone – early-ripening, in the center – early-ripening and medium-ripening, in the south – medium-early-ripening [6].

It should be noted that the vast majority of already existing breeds are very sensitive to adverse growing conditions, under which productivity is significantly reduced, so breeders direct their efforts to create more plastic, high-yielding breeds that are less sensitive to extreme environmental factors and are suitable for cultivation using intensive technologies and as a result, over the last decade, the varieties resistant to adverse growing conditions, cracking of beans, breeds characterized by a stable harvest and increased content of protein and oil in the grain, as well as due to early maturity, serve as a good precursor for growing winter wheat [4].

Objectives Setting. Considering the fact that in the conditions of the Western Forest Steppe, new precocious soybean varieties of Ukrainian selection have not yet been sufficiently studied, the task of the present research was to comprehensively assess the response of each variety to the growing conditions of the studied area.

Presenting Main Material. In the course of 2017–2020, field studies were conducted at the experimental field of the Department of Technologies in Plant Breeding of Lviv National Agrarian University with the aim of studying new precocious soybean varieties of Ukrainian selection. The registered area of the site was 20 m^2. The varieties were placed by randomization method. The experiment was repeated three times. In the research the following soybean varieties were used, namely Ustia, Muza, Arnica, Khvylia, Vilshanka, Siverka, Vyshyvanka (originator of the NSC «Institute of Agriculture of the National Academy of Sciences»). During the growing season, the experiment was accompanied by records and laboratory analysis by the following methods [1; 3].

Usta variety was entered into the Register of varieties of Ukraine in 2002. It was bred by the method of individual selection from a hybrid from crossing the breeds Bilosnizhka × Zhemchuzhna.

The height of the plants is 70–75 cm, the attachment of the lower beans is 10-13 cm. The inflorescence is a multi-flowered bunch, with 9–14 purple flowers on the peduncle. Beans are coarse-fibered, pubescent, with two or three seeds.

It belongs to the Manchurian subspecies, approbation group of *sordid*. The hypocotyl knee is purple. Stem is with a straight end, brown, with red pubescence. The leaves are triangular, broadly ovate, entire with a pointed tip. Foliage is good. The seeds are oval, yellow, the scar is brown, medium, oval. Weight of 1000 seeds is 155–160 g.

The variety is early ripening, resistant to damage by the most common diseases, as well as against low temperatures during flowering and fruiting. The seeds contain 41–42 % protein and 19–20 % oil.

Muza variety is in the State Register since 2015, bred by the method of repeated individual selection from hybrid generations of Yug–30/Ustia. The pubescence of the plants is red. The leaves are

trifoliate, the shape of the middle leaf is broadly ovate. The flower is purple. The seeds are oval, yellow, the scar is brown. The weight of 1000 seeds is 235–245 g. The seeds contain 41–42 % protein and 20–21 % fat. The height of the plants is 85-90 cm. The variety is early-ripening (ripens in 100–102 days in the conditions of Kyiv region). It is characterized by high resistance to cracking of beans and shedding, guaranteed use as a precursor for winter crops in all zones of association. It is resistant to the most common diseases, as well as to low temperatures during flowering and fruiting [5].

Arnica variety was introduced into the State Register in 2016, derived by the method of individual selection from a combination of crossing two early maturing and productive lines 242 and 427. This variety is more precocious than all ultra-precocious breeds known in Ukraine. The seed is oval, yellow, the stigma is yellow, medium, oval with a white eye. The height of the plants is 75–80 cm. The weight of 1000 seeds is 155–160 g, seeds contain 40–42 % protein and 20–21 % fat. It is ultra-early ripening variety (ripens in 83–85 days in the conditions of Kyiv region) [5].

Khvylia variety is in the State Register since 2013, bred by the method of individual selection from the L.364/Cherniatka hybrid population. The pubescence of the plant is gray. The leaves are triangular, and the shape of the middle leaf is broadly ovate. The seed is oval, yellow, the scar is yellow with a white «eye». The weight of 1000 seeds is 158–162 g. The seeds contain 40–42 % protein and 21–22 % fat. The height of the plants is 85–90 cm. It is early ripening variety (ripens in 102–107 days in the conditions of Kyiv region). The variety is resistant to cracking of beans and shedding of grain, guaranteed use as a precursor for winter crops in all zones of association, suitable for harvest crops. It is resistant to the most common diseases, as well as to low temperatures during flowering and fruiting. The variety is recommended for the main crops of Forest-Steppe regions of Ukraine and Polissia [5].

Vilshanka variety is in the State Register since 2011, bred by the method of repeated individual selection from the L.955/Cherniatka hybrid. It belongs to the Manchurian subspecies, approbation group *ukrainika*. The growth type of the plant is intermediate. The plumage is red. The leaves are triangular, and the shape of a broad leaf is broadly ovate. The flower is purple. The seed is oval, yellow, the scar is brown, medium, oval with a white «eye». The weight of 1000 seeds is 240–250 g. The seeds contain 41–42 % protein and 21–22 % fat. It is resistant to the most common diseases, as well as to

low temperatures during flowering and fruiting. The height of the plants is 92–95 cm. The height of attachment of the lower beans is 13–15 cm. It is precocious. The variety is recommended for growing in the Forest-Steppe regions of Ukraine as the main crops. Due to its early maturity, it can be used as a precursor to winter crops [5].

Siverka variety is in the State Register since 2013, bred by the method of individual selection from the Yug-30/Ustia hybrid population. The pubescence of plants is gray. The leaves are triangular, and the shape of the middle leaf is broadly ovate. The seeds are oval, yellow, the scar is yellow. The weight of 1000 seeds is 170–175 g. The seeds contain 41–42 % protein and 20–21 % fat. The height of the plants is 87–95 cm. It is early ripening variety (ripens in 95–97 days in the conditions of Kyiv region). The variety can be used as a guaranteed predecessor for winter crops in all zones of coexistence and is suitable for harvest crops. It is recommended for main and fallow crops in the Forest-Steppe areas of Ukraine and Polissia [5].

Vyshyvanka variety is in the State Register since 2019. The weight of 1000 seeds is 144–183 g. The seeds contain 38–39 % protein and 22–23 % fat. The variety is precocious – the growing season, depending on the growing zone, is 104–115 days. The height of the attachment of the lower bean is 11.4–13.4 cm. It is characterized by increased resistance to the main diseases (peronosporosis, ascochitosis, septoriosis, fusariosis, bacteriosis).

Suziria variety is medium-ripe. It was bred by the method of multiple individual selection from a hybrid from crossing Yug-30/Cherniatka. Belongs to the Manchurian subspecies, approbation group *sordida*. In 2011, it was introduced into the State Register of plant varieties suitable for distribution in Ukraine in the Forest Steppe and Polissia zones. The height of the plants is 90–92 cm. The height of attachment of the lower beans is 13–15 cm. The stem is dark brown with red pubescence. The seeds are oval, yellow, the scar is brown, medium, oval. The weight of 1000 seeds is 220–240 g. The seeds contain 42–43 % protein and 20–21 % fat [5].

They were sown with a row width of 12.5 at the sowing rate of 600,000 seeds/ha. Before sowing, inoculation was carried out with the bacterial fertilizer Optimays.

The following herbicides were used to control weeds, namely Harness (before seedlings) at the rate of 2.5 l/ha and Bazagran (after seedlings in the phase of 2–3 leaves of the crop) – 2.5 l/ha.

Harvesting was carried out in the phase of full seed maturity (at a moisture content of 14 %). Desiccation was not used.

As a result of the four-year research (2017–2020), the following yields were obtained (Table 1). It should be noted that all the varieties that were put to study were characterized by increased productivity, however, the most productive variety was Muza, which provided a yield of 3.99 t/ha, which is by 1.15 t/ha, or 40.3 % higher than the control (Ustia breed).

An important feature is that the content and composition of protein and oil in soybeans are determined genetically, but in turn they are also closely related to the external conditions of the growing season.

It should be noted that, on average, during four years of research, when grown in the Western Forest-Steppe zone, the varieties that were put to study were characterized by increased seed quality indicators.

Within the scope of the experiment, these indicators were at the level of 35.4–41.8 % (protein) and 18.8–20.9 % (oil) depending on the variety, (Table 2). High protein content was noted in such varieties as Vilshanka (39.2 %), Siverka (39.5 %), Muza (40.7 %). The highest protein content was observed in the Suziria variety – 41.8 %.

Table 1

Yield of soybean varieties, on average for 2017–2020, t/ha

Variety	Productivity, t/ha	Growth by Grade	
		t/ha	%
Ustia – *control*	2.84	–	–
Muza	3.99	1.15	40.3
Arnica	2.87	0.03	1.0
Khvylia	2.90	0.06	2.1
Vilshanka	3.38	0.54	19.0
Siverka	2.99	0.15	5.3
Vyshyvanka	3.08	0.24	8.5
Suziria	3.21	0.37	13.0

HIP $_{05}$ t/ha: 2017 – 0.11; 2018 – 0.13; 2019 – 0.12; 2020 – 0.12.

Table 2

Qualitative Indicators of grain of soybean varieties, Average for 2019–2020, %

Variety	Protein, %	Oil,%
Ustia – *control*	36.4	18.8
Muza	40.7	19.5
Arnica	37.8	18.9
Khvylia	38.9	19.4
Vilshanka	39.2	19.9
Siverka	39.5	20.1
Vyshyvanka	38.3	19.4
Suziria	41.8	20.9

Conclusions. To conclude, the study of the precocious soybean varieties of Ukrainian selection in the conditions of the Western Forest-Steppe of Ukraine provides an opportunity to solve the issue of full realization of their genetic potential, as well as obtaining a grain yield at the level of 2.84–3.99 t/ha with high seed quality indicators.

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